

DISCUSSION OF THE AMENDMENT

Claim 1 has been amended by incorporating the subject matter of Claims 2 and 5 therein, and a hydrogen chloride conversion, as supported in the specification at page 6, lines 21-22; Claims 2, 5 and 9 have been canceled.

No new matter is believed to have been added by the above amendment. Claims 1, 3, 4 and 6-8 are now pending in the application.

REMARKS

The rejection of Claims 1 and 6-8 under 35 U.S.C. § 102(b) as anticipated by US 4,774,070 (Itoh et al), is respectfully traversed. The above-amended claims all contain the limitations of at least Claim 5, not subject to this rejection. Accordingly, it is respectfully requested that the rejection be withdrawn.

The rejection of Claims 1-9 under 35 U.S.C. § 103(a) as unpatentable over Itoh et al in view of US 5,908,607 (Abekawa et al), is respectfully traversed.

As recited in above-amended Claim 1, an embodiment of the present invention is a process for preparing chlorine by catalytic gas-phase oxidation of hydrogen chloride, which comprises the steps: a) providing a feed gas stream I comprising hydrogen chloride and a feed gas stream II comprising oxygen; b) in a first oxidation stage, feeding the feed gas stream I, the feed gas stream II, into a first oxidation zone and bringing them into contact with a first oxidation catalyst so that a first partial amount of the hydrogen chloride is oxidized to chlorine and a gas stream III comprising chlorine, unreacted oxygen, unreacted hydrogen chloride and water vapor is obtained; c) in a second oxidation stage, feeding the gas stream III into a second oxidation zone and bringing it into contact with at least one further oxidation catalyst so that a second partial amount of the hydrogen chloride is oxidized to chlorine and a product gas stream IV comprising chlorine, unreacted oxygen, unreacted hydrogen chloride and water vapor is obtained; d) isolating chlorine, from the product gas stream IV, wherein the first oxidization catalyst in the first oxidation zone is present in a fluidized bed and the further oxidation catalyst or catalysts in the second oxidation zone is/are present in a fixed bed, wherein the temperature in the first oxidation zone is from 280 to 360°C and that in the second oxidation zone is from 220 to 320°C, wherein the oxidation catalysts comprise ruthenium oxide on a support selected from the group consisting of silicon

dioxide, aluminum oxide, titanium dioxide and zirconium dioxide, and wherein the hydrogen chloride conversion in the first oxidation stage b) is from 40 to 80%.

Itoh et al is drawn to a process for producing chlorine by oxidizing byproduced hydrogen chloride in the presence of a catalyst which contains chromic oxide as a principal component (Abstract). The reaction may be carried out in a fixed-bed reactor with catalyst packed therein, a fluidized-bed reactor with the catalyst maintained in a fluidized state, or a reactor making use of both fixed-bed and fluidized-bed systems (column 5, lines 24-29).

The Examiner relies on Abekawa et al for its disclosure of a ruthenium oxide catalyst on a support in a process for producing chlorine. The Examiner holds that it would have been obvious to use the ruthenium oxide-supported catalyst of Abekawa et al as the catalyst in the process of Itoh et al.

In reply, while Itoh et al discloses that a fixed-bed reactor and fluidized-bed reactor may be used in combination, there is no disclosure or suggestion of using them in a particular order, or that there is any advantage from using the combination as opposed to one kind alone. In addition, Itoh et al is limited to a specific chromic oxide-containing catalyst. In that regard, it is noted that Abekawa et al also discloses the alternative use of fixed bed and fluidized bed systems (column 6, line 45ff), but no disclosure of combining them.

As described in the specification beginning at page 1, line 24, the present invention addresses the specific problem of the formation of "hot spots" which adversely affect the life of the catalyst on the one hand, and the problem of low space-time yields associated with reaction temperatures low enough to avoid such hot spots, on the other hand.

This problem is solved by the specific reaction conditions as recited in above-amended Claim 1. The inventors have found that, when employing a catalyst containing ruthenium oxide on a support material, as recited in above-amended Claim 1, the formation of hot spots can be avoided by carrying out a first oxidation stage in a fluidized-bed reactor at

a temperature from 280 to 360°C until a hydrogen chloride conversion of at least 40% and at most 80% is reached, and carrying out a second oxidation stage in a fixed-bed reactor at a temperature from 220 to 320°C. At the same time, a sufficiently high space-time yield is achieved, since the first oxidation stage is carried out at a rather high temperature, and complete conversion of hydrogen chloride is achieved since the second reaction stage is carried out at a lower temperature in order to achieve the optimum thermodynamic equilibrium position. Since partial conversion takes place in the first fluidized-bed stage b) and the resulting gas stream is diluted with product gases, there remains only a small risk of formation of hot spots in the (second) fixed-bed reactor stage c).

There is no clue in either Itoh et al or Abekawa et al to carry out, using a ruthenium oxide catalyst, a first fluidized-bed oxidation stage and a second fixed-bed oxidation stage under the process conditions as defined in above-amended Claim 1, in order to solve the problem addressed by the present invention.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

All of the presently-pending claims in this application are now believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Customer Number

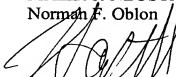
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